

### Number of Rises

A bimodal spring rise is the preferred alternative, but due to insufficient storage a reduced number of rises may be necessary. Plans for one rise should be developed for periods of extended drought and no rise when storage gets very low.

### Flood Control Targets

Flood control targets are in the Master Manual for the purpose of balancing the need to evacuate water from the reservoirs with the need to prevent downstream flooding. There are no hard numbers targets, only relative increments compared to the service level. They may be adjusted by plus or minus 5,000 cfs depending on hydro-meteorological conditions. The targets are:

Location	Relative flow level above which the system releases would be reduced to <b>full service</b> releases	Relative flow level above which the system releases would be reduced to <b>minimum service</b> releases
Omaha	+6,000 cfs	+15,000 cfs
Nebraska City	+12,000 cfs	+20,000 cfs
Kansas City	+30,000 cfs	+60,000 cfs

The Corps has stated that in order to have a spring rise, the flood control targets must be incrementally increased. In other words, the magnitude alone of the spring rises exceeds the flood control targets and would cause them to automatically be shut off. The purpose of increasing the flood control targets is to balance the needs of the endangered species with the needs to prevent downstream flooding. The maximum amount of the increase in flood control targets modeled was 16,000 cfs. The minimum amount has not been defined in the Corps modeling, but possibly nears 4,000 cfs.

### Timing, Duration, and Magnitude of a single mode rise

The timing, duration, and magnitude components could be based on set numbers, guide curves, or set during an AOP process using adaptive management.

This rise should start between the start of the navigation season and July 1<sup>st</sup>. This large window allows the rise range from coinciding with the start of the navigation season to occurring when the hydropower is most valuable. When the spring rise occurs after the birds begin to nest, the chance for exceeding the allowed take increases significantly.

The duration of the peak of a single rise should range from 2 to 14 days. The duration should be based on the purpose of the rise. A shorter duration rise more closely mimics a natural rise and does save water. A longer duration rise may be useful for preparing the channel by clearing silt from gravels and conditioning portions of sandbars.

The rise magnitude should range from +8,000 to +20,000 cfs. When the peak duration is short, a larger magnitude rise can be achieved with less chance of downstream flooding impacts because the peak will be attenuated (diminish) as it travels downstream. For instance the peaking the Corps did out of Gavins Point (+6000 cfs for a day) this spring was not noticeable by the time the flows reached Omaha.

When it appears that the navigation season will be shortened by more than two weeks, it may be possible to benefit multiple interests by delaying the start of the navigation season. Saving water early in the season has positive benefits to reservoir recreation and wildlife and Mississippi River navigation.

### **Service level provided prior to a single mode rise**

The service level provided prior to the single rise should range from winter releases to full service releases. With lower the service levels, a greater magnitude rise can be with fewer potential downstream flooding impacts.

### **Timing, Duration, and Magnitude of the first rise of the bimodal rise**

This rise should start between the start of the navigation season and the start of the bird nesting period. This large window allows the rise range from coinciding with the start of the navigation season to occurring when an additional rise will already occur as the birds begin to nest.

The duration of the peak of the first rise should range from 2 to 7 days. As with the single rise, the duration should be based on the purpose of the rise. A shorter duration rise more closely mimics a natural rise and does save water. A longer duration rise may be useful for preparing the channel by clearing silt from gravels and conditioning portions of sandbars.

The rise magnitude should range from +4,000 to +12,000 cfs. When the peak duration is short, a larger magnitude rise can be achieved with less chance of downstream flooding impacts because the peak will be attenuated (diminish) as it travels downstream.

### **Service level provided during the inter-rise period of bimodal rises**

The magnitude should range between full service and minimum service levels.

### **Timing, Duration, and Magnitude of the second rise of the bimodal rise**

This rise should start between the start of the bird nesting season and July 1<sup>st</sup>. This large window allows the rise range from occurring when an additional rise will already occur as the birds begin to nest to occurring when the hydropower is most valuable.

The duration of the peak of the second rise should range from 2 to 14 days. The duration should be based on the purpose of the rise. A shorter duration rise more closely mimics a

natural rise and does save water. A longer duration rise may be useful for preparing the channel by clearing silt from gravels and conditioning portions of sandbars.

The rise magnitude should range from +8,000 to +20,000 cfs. When the peak duration is short, a larger magnitude rise can be achieved with less chance of downstream flooding impacts because the peak will be attenuated (diminish) as it travels downstream.

### **Navigation Season Length**

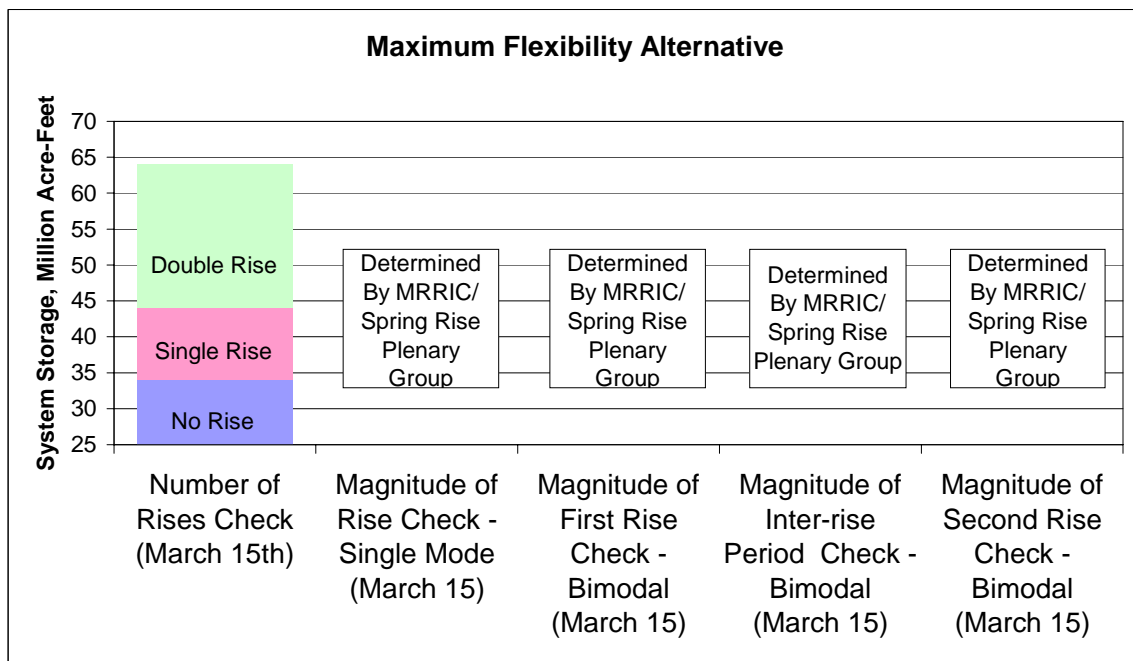
The navigation season length is determined by the July 1 storage check will set the total length navigation season, the season will be extended accordingly into the fall to make up for the lack of the early season under the May Rise Alternative with the single modal spring rise.

The purpose of this alternative is to provide MRRIC as much flexibility as possible to design an annual spring rise. Most of the specific parameters of the spring rise would be formulated through an AOP process.

### Number of Rises

A bimodal spring rise would occur if the March 15 storage is above 41 MAF and a single mode rise would occur if the March 15 storage is above 34MAF. If system storage is below 34 MAF no spring rise will occur.

### Guide Curves



### Flood Control Targets

Increased minimally.

### Timing, Duration, and Magnitude of a single mode rise

The intended purpose of a single mode rise determines its characteristics and therefore a set of guide curves cannot be developed. This type of spring rise will only occur when the system storage is very low and therefore it will be very important to plan the rise with the utmost care. The MRRIC or Spring Rise Plenary group should determine the purpose of the rise based on information from the Pallid Workgroup and set the parameters accordingly. For instance, if the purpose was to monitor the need and effects of the early rise, a rise that coincides with the start of the navigation season, has a +5,000 cfs magnitude and a week duration could be selected. Or if the purpose was to take

advantage of the rise necessary when the birds begin to nest, a rise of +16,000 cfs starting around May 1<sup>st</sup> could be selected. The service level provided prior to the rise would also need to be set based on the purpose of the rise.

### **Timing, Duration, and Magnitude of a First Rise**

The purpose of the rise would determine its magnitude and duration. The timing of the rise would most likely coincide with the beginning of the navigation season.

A channel conditioning rise would have a longer duration and a rise seeking a biologic response may have a larger magnitude with a much shorter peak duration.

### **Service level provided during the inter-rise period of bimodal rises**

The service level provided during the inter-rise period would be based on system storage and the need to evacuate water.

### **Timing, Duration, and Magnitude of a Second Rise**

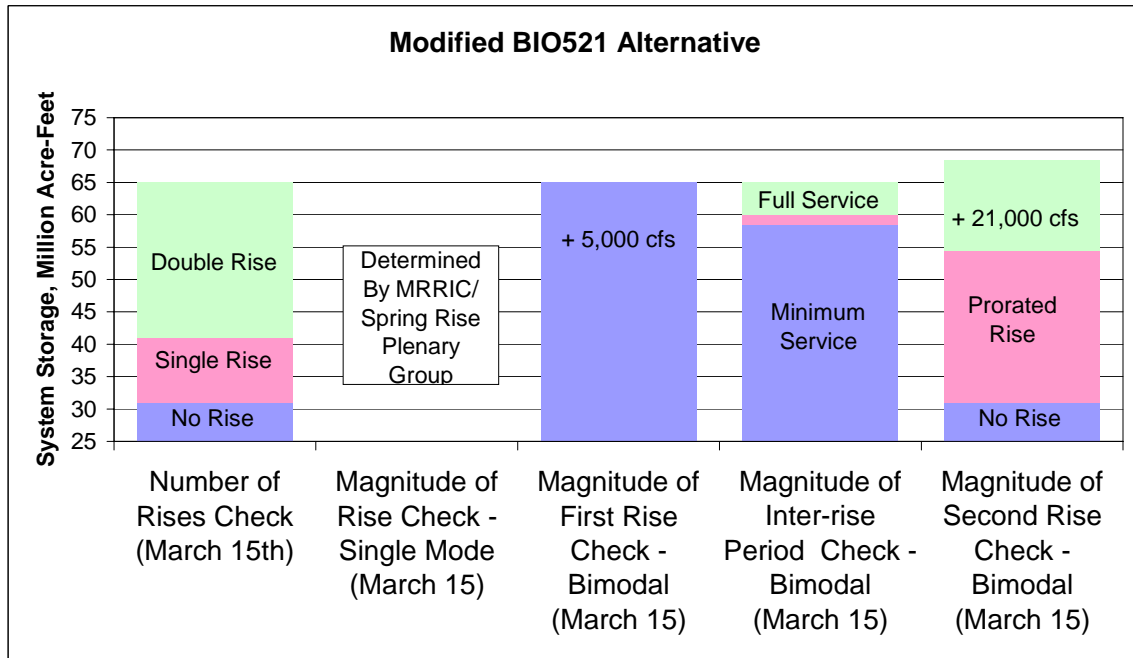
This rise would be designed annually to meet specific needs of the sturgeon or birds. The only limitations are that the peak flow is not to exceed +20,000 cfs and that the peak duration will not be greater than 2 weeks.

This alternative is based on the BIO521 modeled by the Corps and modified based on comments and information from the technical work group meetings.

### Number of Rises

A bimodal spring rise would occur if the March 15 storage is above 41 MAF and a single mode rise would occur if the March 15 storage is above 31MAF. If system storage is below 31 MAF no spring rise will occur.

### Guide Curves



### Flood Control Targets

Increased +16,000 cfs.

### Timing, Duration, and Magnitude of a single mode rise

The intended purpose of a single mode rise determines its characteristics and therefore a set of guide curves cannot be developed. This type of spring rise will only occur when the system storage is very low and therefore it will be very important to plan the rise with the utmost care. The MRRIC or Spring Rise Plenary group should determine the purpose of the rise based on information from the Pallid Workgroup and set the parameters accordingly. For instance, if the purpose was to monitor the need and effects of the early rise, a rise that coincides with the start of the navigation season, has a +5,000 cfs magnitude and a week duration could be selected. Or if the purpose was to take advantage of the rise necessary when the birds begin to nest, a rise of +16,000 cfs starting

around May 1<sup>st</sup> could be selected. The service level provided prior to the rise would also need to be set based on the purpose of the rise.

### **Timing, Duration, and Magnitude of a First Rise**

The rise would coincide with flow release increase for navigation support starting March 23. The magnitude and duration of this rise would be constant at +5,000 cfs for one week.

### **Service level provided during the inter-rise period of bimodal rises**

The modified guide curve developed by the Corps of Engineers would remain for this alternative. If system storage was greater than 60 MAF, full service releases would be made and if the system storage was less than 58.5 MAF, minimum service releases would be made. The service level would be interpolated between minimum service and full service for storage volumes between 58.5 and 60 MAF.

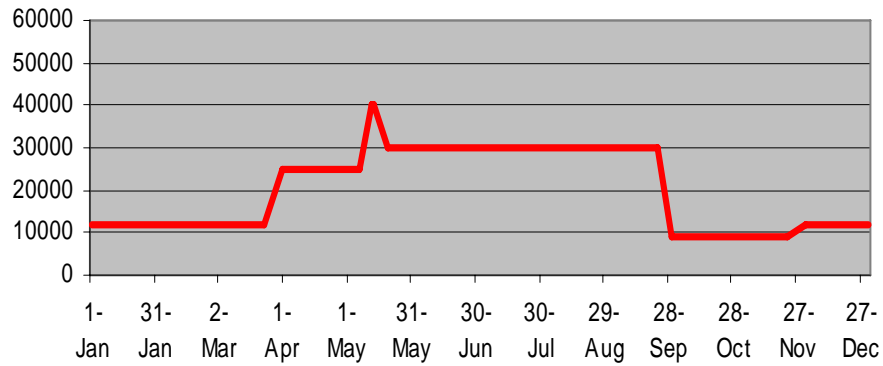
### **Timing, Duration, and Magnitude of a Second Rise**

The rise should begin either with the nesting of the birds or when the river temperature gets to 17 degrees Celsius, which ever is earlier.

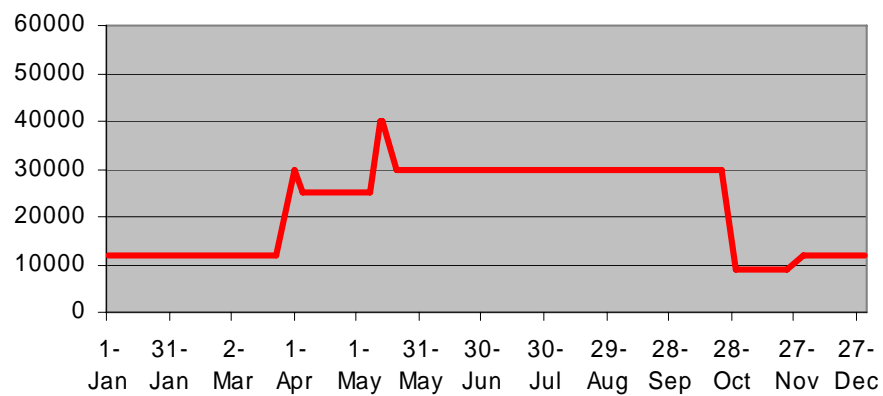
The flow rates should increase 3,000 cfs/day with a peak magnitude increase determined by system storage (with a maximum of +21,000 cfs). The duration of the peak should be 1 day and the decline should decrease at a rate of 1,500 cfs/day. The total length of the rise would be 22 days under the maximum conditions.

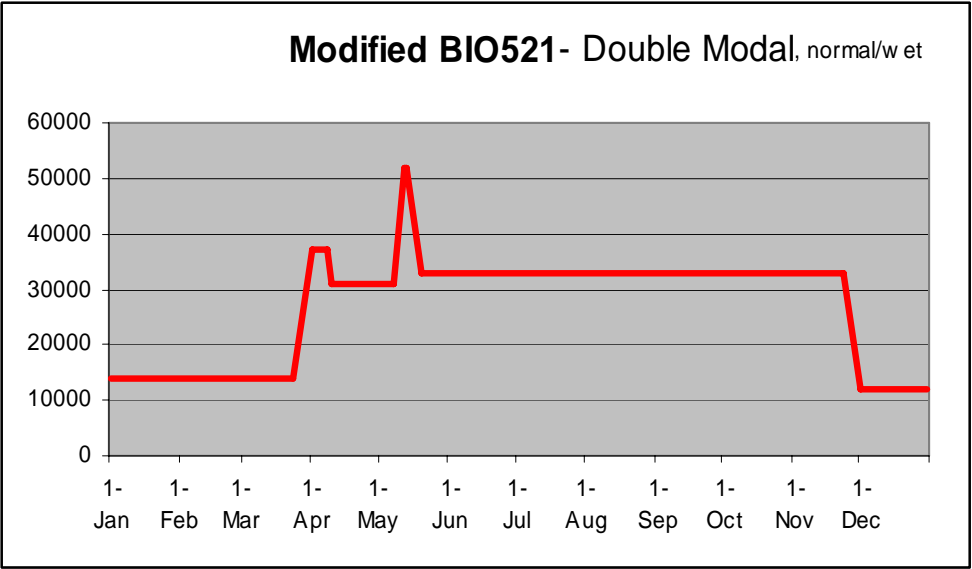
## Idealized Hydrographs

**Modified BIO521- Single Modal, Very Dry Conditions**



**Modified BIO521- Double Modal, Dry Conditions**



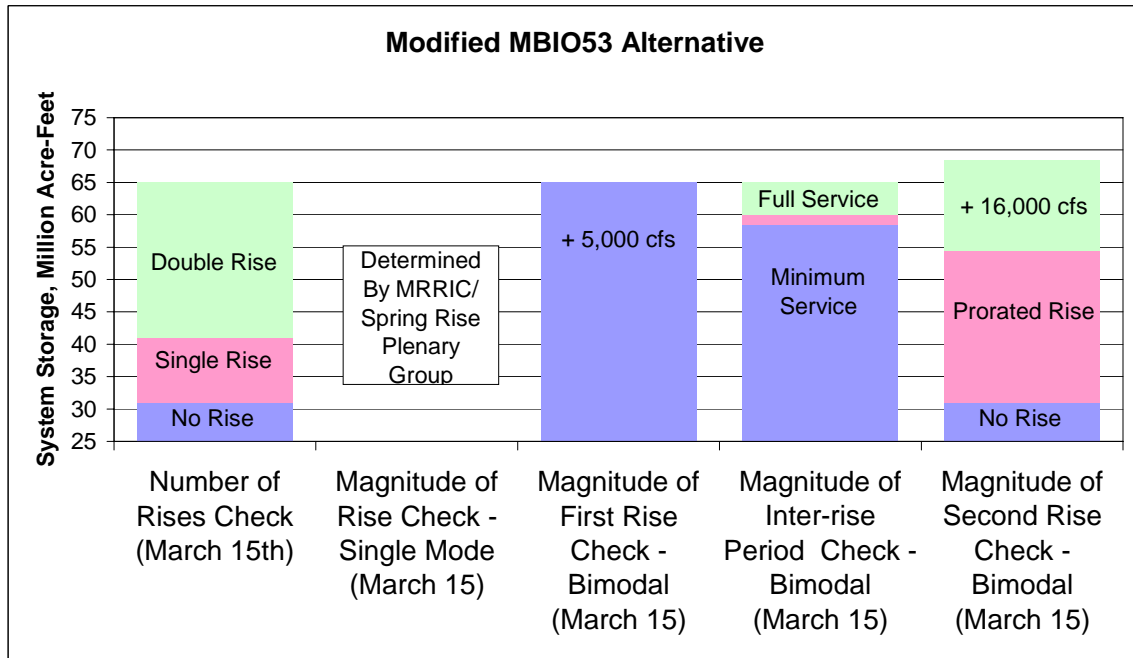


This alternative is based on the MBIO53 modeled by the Corps and modified based on comments and information from the technical work group meetings.

### Number of Rises

A bimodal spring rise would occur if the March 15 storage is above 41 MAF and a single mode rise would occur if the March 15 storage is above 31MAF. If system storage is below 31 MAF no spring rise will occur.

### Guide Curves



### Flood Control Targets

Increased minimally.

### Timing, Duration, and Magnitude of a single mode rise

The intended purpose of a single mode rise determines its characteristics and therefore a set of guide curves cannot be developed. This type of spring rise will only occur when the system storage is very low and therefore it will be very important to plan the rise with the utmost care. The MRRIC or Spring Rise Plenary group should determine the purpose of the rise based on information from the Pallid Workgroup and set the parameters accordingly. For instance, if the purpose was to monitor the need and effects of the early rise, a rise that coincides with the start of the navigation season, has a +5,000 cfs magnitude and a week duration could be selected. Or if the purpose was to take advantage of the rise necessary when the birds begin to nest, a rise of +16,000 cfs starting

around May 1<sup>st</sup> could be selected. The service level provided prior to the rise would also need to be set based on the purpose of the rise.

### **Timing, Duration, and Magnitude of a First Rise**

The rise would coincide with flow release increase for navigation support starting March 23. The magnitude and duration of this rise would be constant at +5,000 cfs for one week.

### **Service level provided during the inter-rise period of bimodal rises**

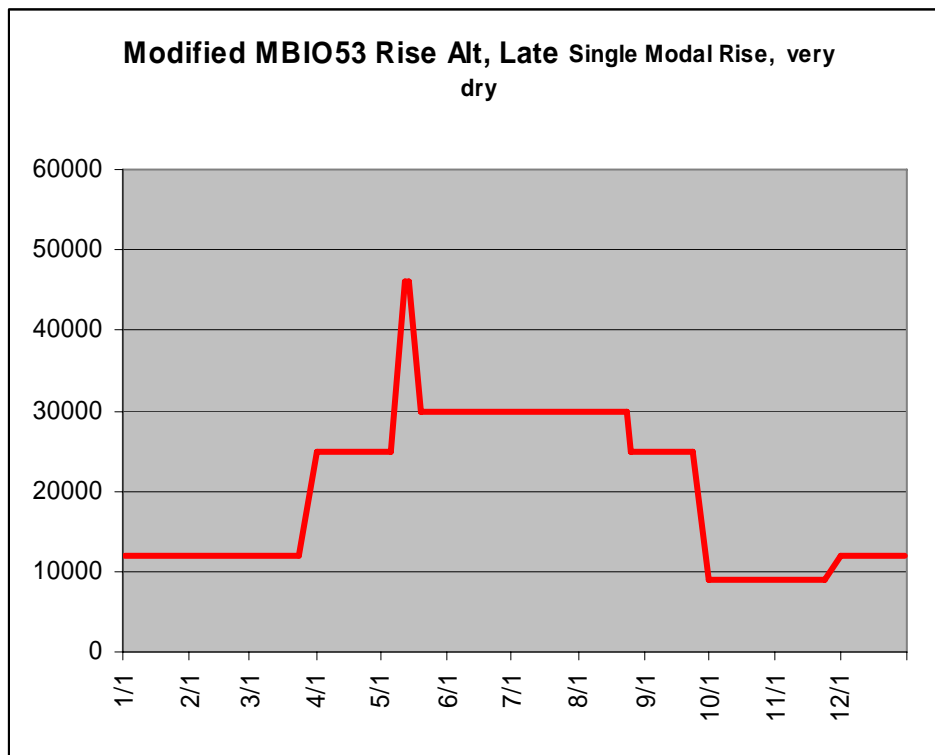
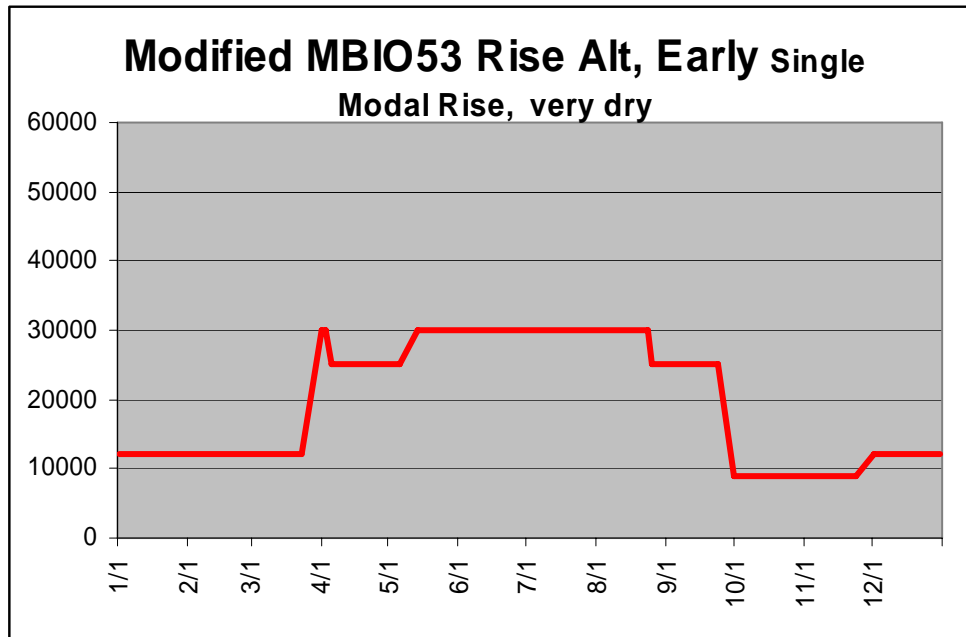
The modified guide curve developed by the Corps of Engineers would remain for this alternative. If system storage was greater than 60 MAF, full service releases would be made and if the system storage was less than 58.5 MAF, minimum service releases would be made. The service level would be interpolated between minimum service and full service for storage volumes between 58.5 and 60 MAF.

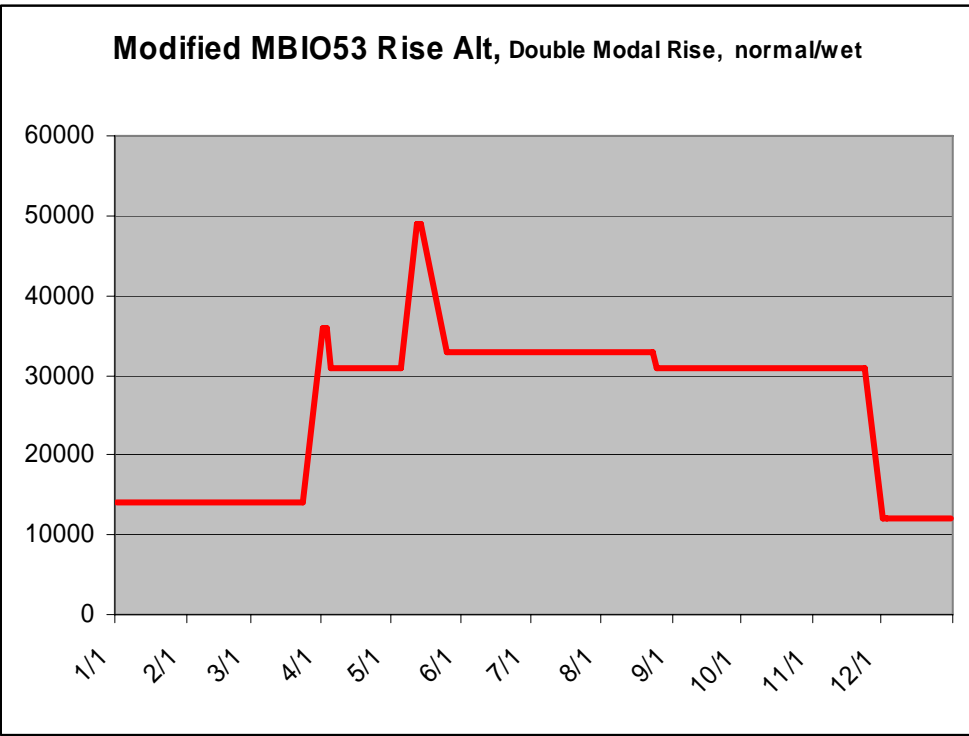
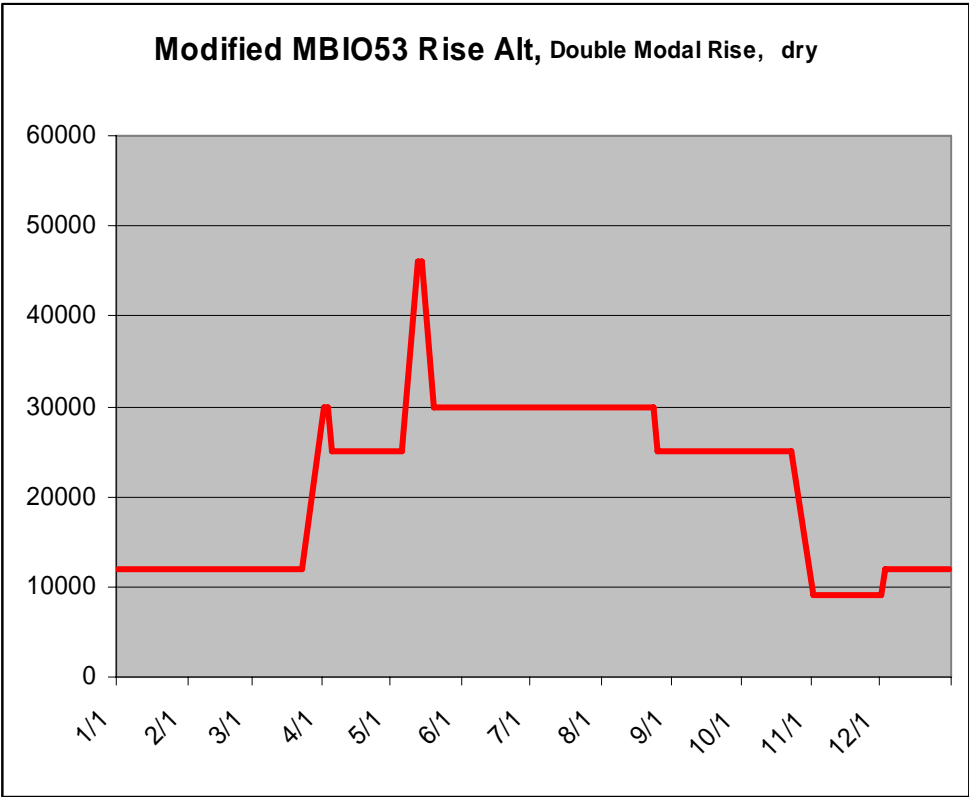
### **Timing, Duration, and Magnitude of a Second Rise**

The rise should begin either with the nesting of the birds or when the river temperature gets to 17 degrees Celsius, which ever is earlier.

The flow rates should increase 3,000 cfs/day with a peak magnitude increase determined by system storage (with a maximum of +16,000 cfs). The duration of the peak should be 1 day and the decline should decrease at a rate of 1,500 cfs/day. The total length of the rise would be 16 days under the maximum conditions.

## Idealized Hydrographs



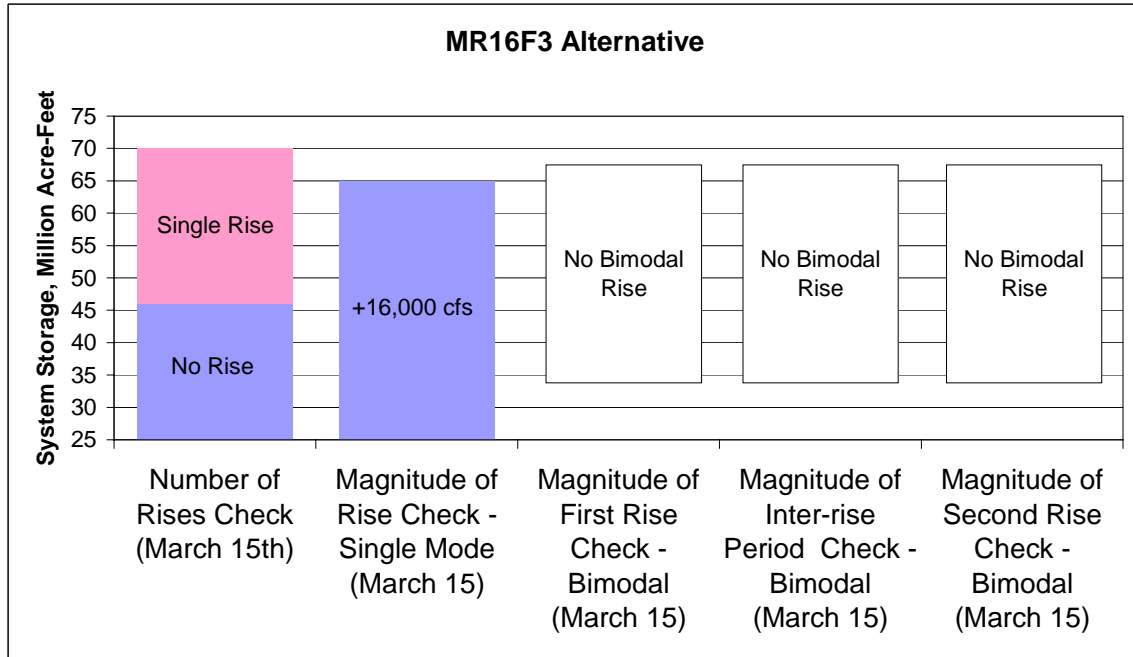


This alternative is different in that it only has one rise. It was modeled by the Corps.

### Number of Rises

A single spring rise will occur if the March 15 storage is above 46 MAF. There is no provision for a bimodal rise.

### Guide Curves



### Flood Control Targets

Increased by 16,000 cfs.

### Timing, Duration, and Magnitude of a single mode rise

This alternative calls for a set Spring rise of +16,000 cfs to occur each year when the storage is greater than 46 MAF on March 15<sup>th</sup>. The duration of the peak is 2 weeks.

### Timing, Duration, and Magnitude of a First Rise

None.

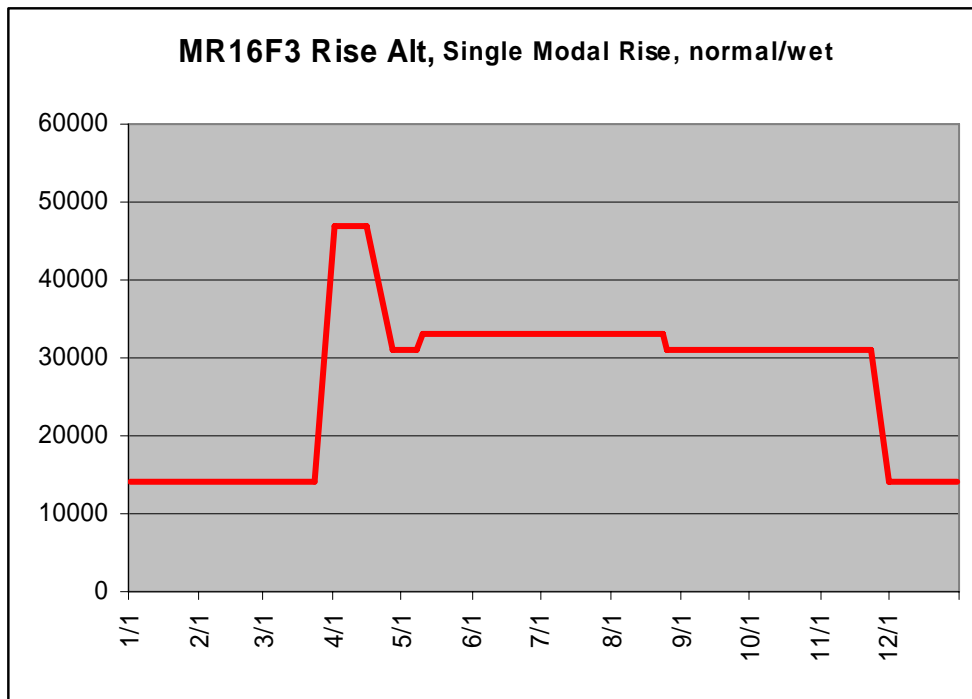
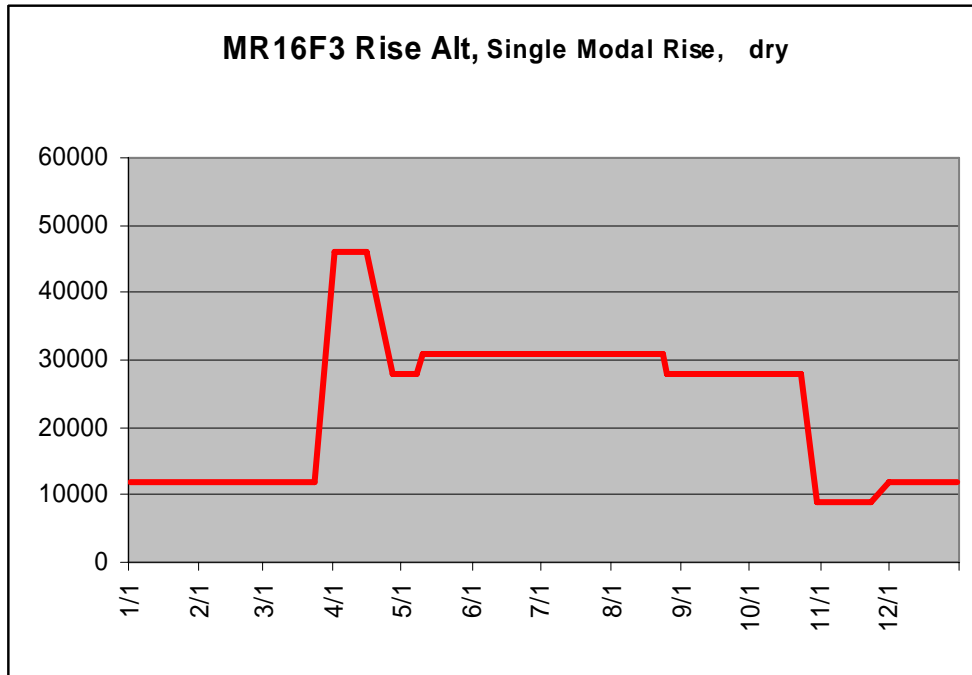
### Service level provided during the inter-rise period of bimodal rises

None.

## **Timing, Duration, and Magnitude of a Second Rise**

None.

## Idealized Hydrographs

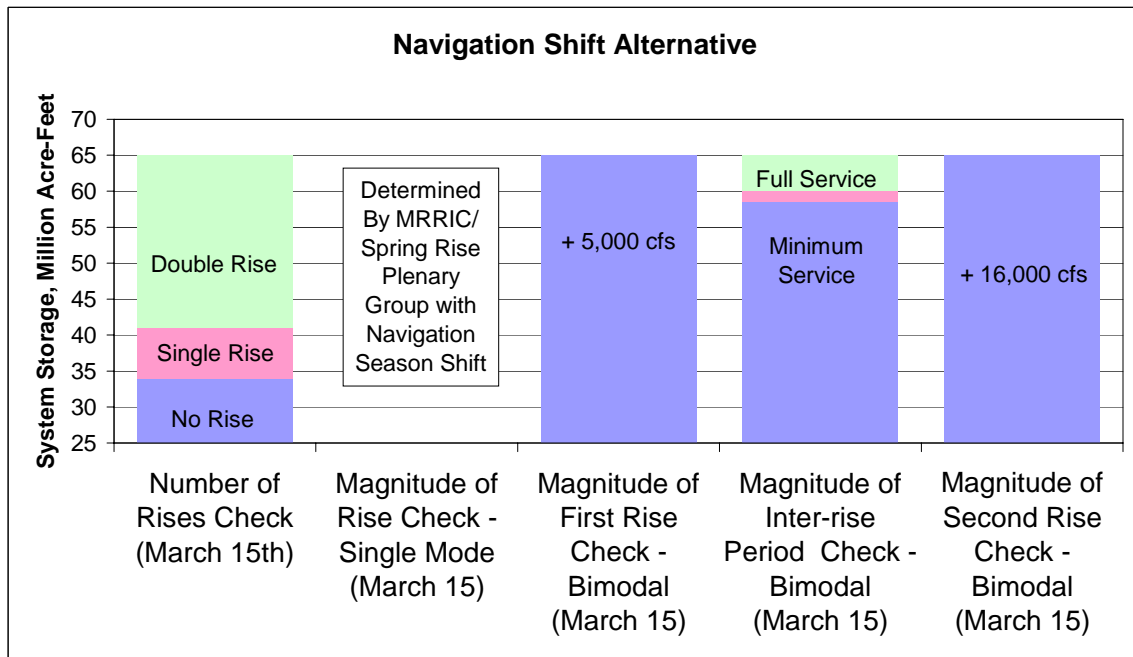


The purpose of this alternative is to provide benefits to the reservoir fisheries and to Mississippi navigation by mandating navigation season shifts during periods of extreme drought and lessen downstream flood impacts. The single mode rise section provides the detail for how this is accomplished.

### Number of Rises

A bimodal spring rise would occur if the March 15 storage is above 41 MAF and a single mode rise would occur if the March 15 storage is above 34MAF. If system storage is below 34 MAF no spring rise will occur.

### Guide Curves



### Flood Control Targets

Increased minimally.

### Timing, Duration, and Magnitude of a single mode rise

Whenever the Corps of Engineers basic forecast predicts a navigation seasoning shortening of two weeks or more, the navigation season shall be delayed between two and six weeks. This will increase the reservoir levels during fish spawning times and cause the navigation season to extend later into the fall, which will provide benefits to the Mississippi River.

The rise itself would be designed based on its intended purpose and therefore a set of guide curves cannot be provided. The MRRIC or Spring Rise Plenary group should determine the purpose of the rise based on information from the Pallid Workgroup and set the parameters accordingly. For instance, if the purpose was to monitor the need and effects of the early rise, a rise that coincides with the start of the navigation season, has a +5,000 cfs magnitude and a week duration could be selected. Or if the purpose was to take advantage of the rise necessary when the birds begin to nest, a rise of +16,000 cfs starting around May 1<sup>st</sup> could be selected.

### **Timing, Duration, and Magnitude of a First Rise**

The rise would coincide with flow release increase for navigation support starting March 23. The magnitude and duration of this rise would be constant at +5,000 cfs for one week.

### **Service level provided during the inter-rise period of bimodal rises**

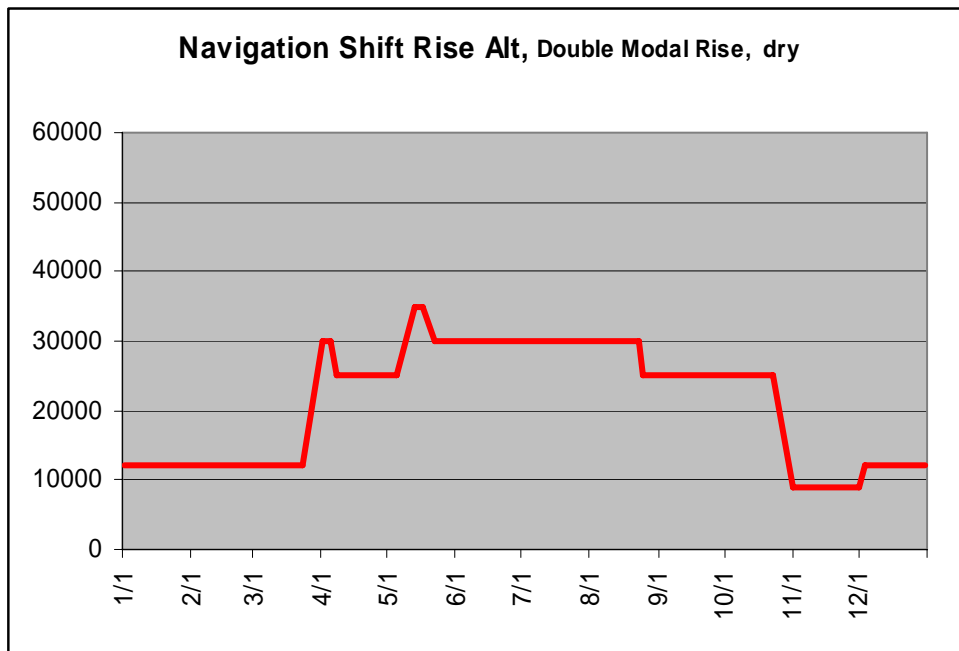
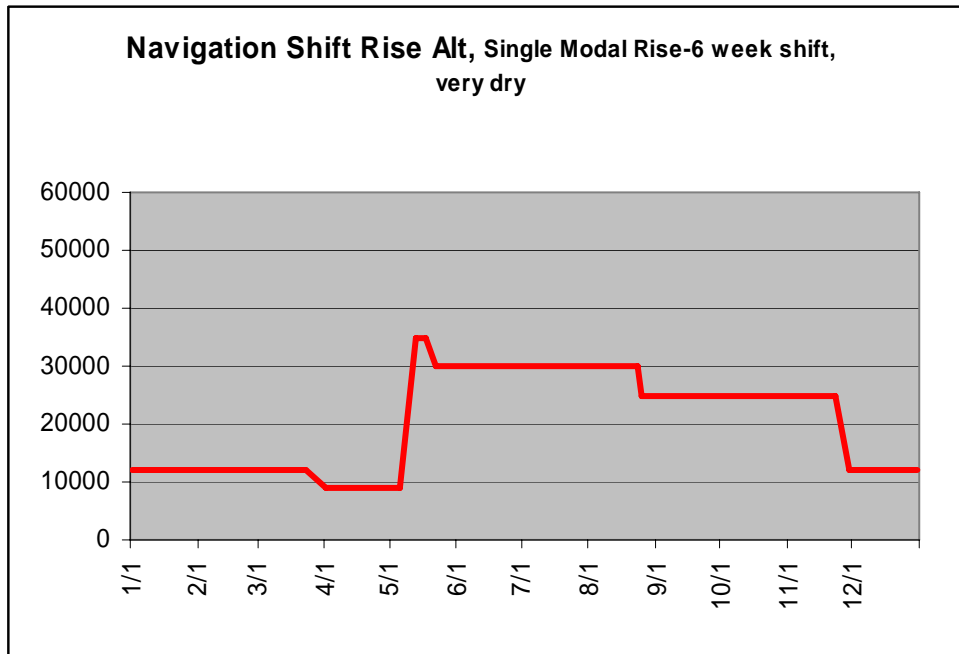
The modified guide curve developed by the Corps of Engineers would remain for this alternative. If system storage was greater than 60 MAF, full service releases would be made and if the system storage was less than 58.5 MAF, minimum service releases would be made. The service level would be interpolated between minimum service and full service for storage volumes between 58.5 and 60 MAF.

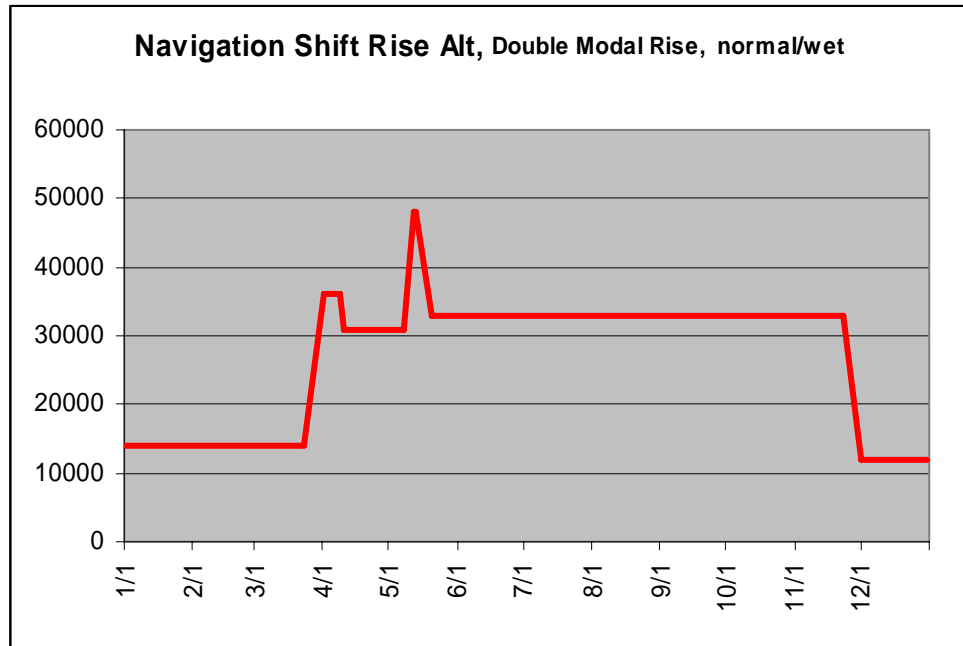
### **Timing, Duration, and Magnitude of a Second Rise**

The rise should begin either with the nesting of the birds or when the river temperature gets to 17 degrees Celsius, whichever is earlier.

The flow rates should increase 3,000 cfs/day for 5 days with a peak magnitude of +16,000 cfs over the navigation service level. The duration of the peak should be 1 day and the decline should decrease at a rate of 1,500 cfs/day for 10 days. The total length of the rise would be 16 days.

## Idealized Hydrographs



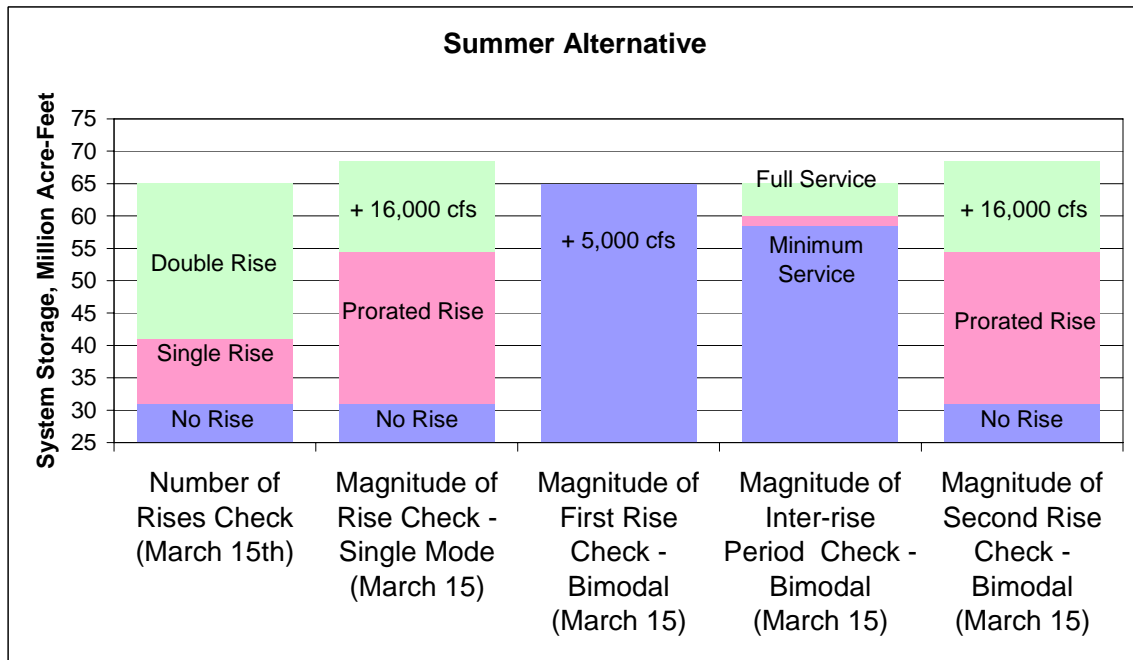


The purpose of this alternative is to move the rise into July.

### Number of Rises

A bimodal spring rise would occur if the March 15 storage is above 41 MAF and a single mode rise would occur if the March 15 storage is above 31 MAF. If system storage is below 31 MAF no spring rise will occur.

### Guide Curves



### Flood Control Targets

Increased +8,000 at Omaha and Nebraska City, no increases at Kansas City.

### Timing, Duration, and Magnitude of a single mode rise

This type of rise would occur during late June and early July. The magnitude would be +16,000 cfs with a peak of 2 days. The purposes of moving the rise into the summer is to reduce the risks of flooding and interior drainage problems during the spring planting season, to increase power production during the period when power costs are the greatest, and to reduce the draw on the reservoirs during the spring spawning period. This rise may closer mimic timing of the second rise as depicted in the run-of-the-river hydrograph.

### Timing, Duration, and Magnitude of a First Rise

The rise may coincide with flow release increase for navigation support starting March 23 or with arrival of the nesting birds in early May. The magnitude and duration of this rise would be constant at +5,000 cfs for up to one week.

### **Service level provided during the inter-rise period of bimodal rises**

The modified guide curve developed by the Corps of Engineers would remain for this alternative. If system storage was greater than 60 MAF, full service releases would be made and if the system storage was less than 58.5 MAF, minimum service releases would be made. The service level would be interpolated between minimum service and full service for storage volumes between 58.5 and 60 MAF.

### **Timing, Duration, and Magnitude of a Second Rise**

The rise should begin in late June or early July.

The flow rates should increase 3,000 cfs/day with a peak magnitude increase determined by system storage (with a maximum of +16,000 cfs). The duration of the peak should be 1 day and the decline should decrease at a rate of 1,500 cfs/day. The total length of the rise would be 22 days under the maximum conditions.

The purposes of moving the rise into the summer is to reduce the risks of flooding and interior drainage problems during the spring planting season, to increase power production during the period when power costs are the greatest, and to reduce the draw on the reservoirs during the spring spawning period. This second rise may closer mimic timing of the second rise as depicted in the run-of-the-river hydrograph.

## Idealized Hydrographs

